

**REMARKS**

Entry of the foregoing, reexamination and reconsideration of the subject application is respectfully requested in light of the amendments above and the comments which follow.

As correctly noted in the Office Action Summary, claims 1-59 were pending. By the present response, claims 9, 12 and 54 have been amended, and claims 60 and 61 have been added. Thus, upon entry of the present response, claims 1-61 are pending and await further consideration on the merits.

Support for the foregoing amendments can be found at least at the following locations in the original disclosure: [0038]; drawing Figure 3; and the original claims.

Entry of the foregoing is appropriate pursuant to 37 C.F.R. §1.116 for at least the following reasons: The foregoing claim amendments either recast dependent claims in independent form or do not create new issues which would require a new search; the foregoing amendments place the application in better form for an appeal; and the foregoing claim amendments clearly act to place the application in condition for allowance.

Applicants thank Examiner Guharay for the courtesies extended to Applicants' representative during a personal interview conducted October 2, 2003. During the interview, a discussion was had concerning the distinctions between the pre-formed nanostructure containing material recited by the presently claimed invention, and the aligned *in situ* form nanostructure material described in *Hsu*, as well as the nanoparticles described by *Gärtner et al.*

***DRAWING OBJECTIONS***

The drawings stand objected to on the grounds set forth on page 2 of the Official Action. In particular, it is asserted that the elements recited in claims 34-38 are not shown in the drawing figures. This assertion is respectfully traversed. Applicants continue to assert that drawing figures are not necessary in order to describe these elements, more particularly, illustrations of these elements are not necessary in order to understand the nature of the invention.

However, in order to advance prosecution, Applicants submit herewith a new Figure 9 which clearly illustrates those elements contained in claims 34-38. Replacement drawing Figures 10 and 11 have also been submitted which correspond to original claims 9 and 10, renumbered as claims 10 and 11. Corresponding amendments have also been made to the specification. In light of the above, reconsideration and withdrawal of the rejection is respectfully.

***CLAIM REJECTIONS UNDER 35 U.S.C. §102***

Claims 1, 5-8, 10-11, 22, 43, 52-53, 55 and 59 stand rejected under 35 U.S.C. §102(e) as being anticipated by U.S. Patent No. 6,448,701 to *Hsu* (hereafter "*Hsu*") on the grounds set forth on pages 2-3 of the Official Action. This rejection is respectfully traversed.

The present invention is directed to an electrode, devices incorporating an electrode, methods of forming such electrodes, and devices which advantageously possess

smaller variances and mean breakdown voltages, increased breakdown reliability, smaller electron emission turn-on requirements, and stable electron emissions at high current densities.

An electrode formed according to the principles of the present invention is embodied by claim 1. Claim 1 recites:

*1. An electrode comprising a first electrode material, an adhesion-promoting layer disposed on at least one surface of the first electrode material, and a layer of pre-formed nanostructure-containing material comprising at least one of nanotubes and nanorods disposed on at least a portion of the adhesion-promoting layer.*

According to a further aspect, a device formed according to the principles of the present invention is defined by claim 52. Claim 52 recites:

*52. A device comprising an electrode, the electrode comprising a first electrode material, an adhesion promoter, and a pre-formed nanostructure-containing material comprising at least one of nanotubes and nanorods.*

*Hsu* fails to anticipate claims 1 or 52.

*Hsu* describes a self-aligned integrally formed nanofilament field emitter array. In this regard, the device of *Hsu* includes a substrate layer (102), a catalyst layer (104), and insulator (106), a gate layer (108), and a plurality of nanofilaments (114) which are in alignment and which are grown *in situ* upon the catalyst layer (104).

By contrast, claims 1, 15 and 52 each require an electrode or a device comprising pre-formed nanostructure-containing material comprising at least one of nanotubes and nanorods.

With regard to the above-noted limitation, it is asserted on page 3 of the Official Action that:

Recitation of "pre-formed nano-structure" simply recites the method of forming nano-structure, however, the method of forming the device is not germane to the issue of patentability of the device itself. Therefore, this limitation has not been given patentable weight.

The above quoted assertion is respectfully traversed, particularly, the refusal to afford the above-noted limitation its proper consideration.

The limitation "pre-formed nanostucture-containing material" is not a process limitation as alleged. Rather, it imparts a structural connotation which distinguishes the present invention from coatings formed *in situ* comprising aligned nanostructures as described in *Hsu*.

As described in detail in the present specification, according to the present invention nanostructures are formed by a suitable process, recovered, and optionally subjected to further processing before being applied onto a substrate surface. As clearly illustrated in Attachment A a layer or coating containing pre-formed nanostructures is quite clearly structurally distinct from a coating or layer formed by growing aligned nanostructures *in situ*. Therefore, when properly interpreted, claims 1 and 52 clearly distinguish over the teachings of *Hsu*.

In support of the above, it is noted that the reviewing authorities have held that terms such as "intermixed," "ground in place," "press fitted," "etched," and "welded" are to be construed as structural, rather than process limitations. Similarly, when the term

"preformed nanostructure-contained material" is properly considered in the context of the disclosure and claims as a whole, it too is a structural limitation which quite clearly distinguishes it from the teachings of the applied prior art. In re Garnero, 412F.2d 276, 16 U.S.P.Q. 221, 223 (C.C.P.A. 1969).

The remaining rejected claims depend either on claims 1 or 52. Thus, these claims are also distinguishable over *Hsu* for at least the same reasons noted above.

***CLAIM REJECTIONS UNDER 35 U.S.C. §103***

Claims 1-9, 12-21, 23-26, 39-42, 45-54 and 56-59 stand rejected under 35 U.S.C. §103(a) as being obvious over U.S. Patent No. 5,866,975 to *Gärtner et al.* (hereafter "*Gärtner et al.*") on the grounds set forth on pages 4-7 of the Official Action. This rejection is respectfully traversed.

Claims 1 and 52 are set forth above.

According to a further aspect, a gas discharge device constructed according to the principles of the present invention as set forth in claim 15. Claim 15 recites:

15. *A gas discharge device comprising a sealed chamber containing at least one noble gas and a plurality of spaced electrodes, at least one electrode comprising a first electrode material, an adhesion-promoting layer disposed on at least one surface of the first electrode material, and a layer of pre-formed nanostructure-containing material comprising at least one of nanotubes and nanorods disposed on at least a portion of the adhesion-promoting layer.*

According to another aspect, a lighting device constructed according to the principles of the present invention as set forth in claim 39. Claim 39 recites:

39. *A lighting device comprising a sealed chamber containing an excitable gas and at plurality of spaced electrodes, at least one of said electrodes comprising a first electrode material, an adhesion-promoting layer disposed on at least one surface of the first electrode material, and a layer of pre-formed nanostructure-containing material comprising at least one of nanotubes and nanorods disposed on at least a portion of the adhesion-promoting layer.*

According to yet another aspect, a method of providing a gas discharge device according to the principles of the present invention as set forth in claim 42. Claim 42 recites:

42. *A method of providing a gas discharge device with smaller variances in mean breakdown voltage, increased breakdown reliability, smaller electron emission turn-on requirements, and stable electron emission at high current density, the gas discharge device comprising a sealed chamber containing at least one noble gas and a plurality of spaced electrodes, the method comprising:*  
*applying an adhesion-promoting layer to a surface of at least one of the plurality of electrodes; and*  
*applying a layer of pre-formed nanostructure-containing material comprising at least one of nanotubes and nanorods on to at least a portion of the adhesion-promoting layer.*

*Gärtner et al.* fails to disclose, or even suggest, the subject matter of the presently claimed invention, as defined by the above-noted claims.

*Gärtner et al.* discloses a low temperature cathode having an emissive nanostructure. The construction described by *Gärtner et al.* includes a holder (20), a metal

layer (22), a substrate (24) and a coating (26) having an active surface layer (28).

According to *Gärtner et al.*, the active surface layer consists of "ultrafine particles", or "nanostructures" (see, e.g. - column 6, lines 41-45). However, as acknowledged in the grounds for rejection, *Gärtner et al.* fails to disclose, or suggest, nanostructure containing materials in the form of at least one of a nanotube or nanorod as required by the presently claimed invention.

In this regard, it is nonetheless asserted in the grounds for rejection that:

It is well known in the art (as disclosed by Applicant) that examples of nanostructure containing materials are nanoparticles, cage like fullerenes, nano-tubes, silicon nano-rods nano-wires. It is noted that Applicant's specific choice of nanotube or nanorod does not solve any of the stated problems or yield any unexpected result that is not within the scope of the teachings applied. Therefore it is considered to be a matter of choice, which a person of ordinary skill in the art would have found obvious to select one of the nanostructure containing materials such as a nanotube or nanorod.

The above quoted assertion is respectfully traversed.

Initially, it is noted that the above-quoted assertions are not based upon teachings contained in the prior art. Rather, they are quite clearly based upon an improper hindsight reconstruction of the prior art, and benefit from Applicants' own disclosure. Thus, the rejection is improper as a matter of law.

Contrary to the unsupported assumptions upon which the grounds for rejection are based, the choice of a nanotube or nanorod type nanostructure over a nanoparticle does in

fact impart specific structural differences, and technical advantages, to the presently claimed invention.

For example, when considering the property of electron field emissions, nanotubes or nanorods provide superior performance and capabilities when compared with nanoparticles. The higher aspect ratio (length/width) of nanotubes and nanorods provide enhanced emission properties compared with nanoparticles of the type described by *Gartner*. In this regard, the difference in emission properties can be seen, for example, by comparing table 1 contained in the Gao et al. article cited concurrently herewith, with Figure 1 of *Gärtner et al.* Contrary to the grounds for rejection, selection of nanorods and/or nanotubes is simply not a "matter of choice" as alleged. Reconsideration and withdrawal of the rejection is respectfully requested.

The remaining rejected claims depend from claims 1, 15, 39, 42 and 52. Thus, these claims are also distinguishable over the teachings of *Gärtner et al.* for at least the same reasons noted above.

In addition, with regard to claims 9, 21, 40, 45 and 54, *Gärtner et al.* also admittedly fails to disclose, or even suggest, nanostructure material in the form of single walled carbon nanotubes as required by the above-noted claims. In this regard, it is asserted in the grounds for rejection that:

Single walled carbon nanotubes are well known suitable nano-structure in the field of electrode material, thus, thus [sic] it would have been obvious to one having ordinary skill in the art at the time the invention was made to use single wall carbon nanotube as the first nano-structure material in the



device of *Gärtner*, since selection of known material on the basis of its suitability for intended use is within the skill of a general worker in the art.

The above-quoted assertion is respectfully traversed. First, Applicants challenge the assertion that single walled carbon nanotubes are "well known suitable nanostructure in the field of electrode material." Applicants respectfully request that should the rejection be maintained, the Examiner provide documentary evidence in the prior art in support of this assertion. Secondly, the grounds for rejection improperly equate that which is "well known" with that which is obvious. Whether or not something is "known" in the prior art, does not automatically render it obvious. Thus, the grounds for rejection are clearly incorrect as a matter of law.

Finally, Applicants challenge the assertion that "selection of known material on the basis of its suitability for intended use is within the skill of the general worker in the art." Should the rejection be maintained, Applicants again request that the Examiner furnish documentary evidence in support of the implied assertion that it is known in the prior art that single wall carbon nanotube material is suitable for use within the context of the requirements of the presently claimed invention. The above-quoted assertion also evidences the fact that the grounds for rejection are clearly based upon the improper use of hindsight reconstruction supported only by Applicants' own disclosure. For at least the above-noted additional reasons, reconsideration and withdrawal of the rejection of claims 9, 21, 40, 45 and 54 is respectfully requested.

With respect to claims 12-13 and 23-24, it is acknowledged on page 6 of the Official Action that *Gärtner et al.* fails to disclose the turn-on voltage requirements sent out and the above-noted claims. Despite this acknowledged deficiency, it is nonetheless asserted that:

. . . however, it would have been obvious to one having ordinary skill in art at the time of invention to obtain a range of thickness as claimed in claim 12-13 and 23-24, since it has been held that where the general conditions of a claim are disclosed in the prior art, discovering the optimum or workable ranges involves only routine skill in the art.

The above quoted assertion is respectfully traversed.

The above quoted assertion is evidence that the above-noted claims have been misconstrued. Specifically, claims 12, 13 and 23-24 do not require a particular "thickness" as asserted. Instead, these claims recite that the electrode be capable of producing a specified emitted electron current over a defined area by subjecting the electrode to a particular turn-on voltage. There is no indication given from the teachings of *Gärtner et al.* that the device constructed as described therein is capable of producing the electron emission behavior required by the above noted claims. Reconsideration and withdrawal of the rejection of these claims is respectfully requested for at least these additional reasons.

Claims 27-31 stand rejected under 35 U.S.C. §103(a) as being obvious over U.S. Patent No. 4,707,762 to *Yapoujin* (hereafter "*Yapoujin*") in view of *Gärtner et al.*, on the grounds set forth on pages 7-8 of the Official Action. This rejection is respectfully traversed.

*Yapoujin* is cited as allegedly teaching a gas discharge tube having spaced electrodes wherein the separation distance therebetween is created by a ceramic spacer. However, even if the teachings of *Yapoujin* were appropriately combined with *Gärtner et al.*, the claimed invention would not result. Namely, *Yapoujin* fails to cure the above noted deficiencies in connection with the teachings of *Gärtner et al.* Reconsideration and withdrawal of the rejection is respectfully requested.

Claims 32-33 and 35 stand rejected under 35 U.S.C. §103(a) as being obvious over U.S. Patent No. 5,557,250 to *Debbaut et al.* (hereafter "*Debbaut et al.*") in view of *Gärtner et al.*, on the grounds set forth on page 8 of the Official Action. This rejection is respectfully traversed.

*Debbaut et al.* is cited as allegedly teaching a telecommunications network including a gas discharge tube having a breakdown voltage within the range specified by the presently claimed invention. *Debbaut et al.* admittedly fails to disclose, or even suggest, an electrode constructed as required by the presently claimed invention. However, even if the teachings of *Debbaut et al.* were combined with *Gärtner et al.* in the manner proposed, the claimed invention would not result. Namely, the teachings of *Debbaut et al.* are not sufficient to cure the deficiencies previously described in connection with the teachings of *Gärtner et al.* Reconsideration and withdrawal of the rejection is respectfully requested.

Claims 34 and 36 stand rejected under 35 U.S.C. §103(a) as being obvious over *Debbaut et al.* in view of *Gärtner et al.*, as set forth above, and further in view of U.S.

Patent No. 5,557,672 to *Perry et al.* (hereafter "*Perry et al.*") on the grounds set forth on page 9 of the Official Action. This rejection is respectfully traversed.

*Perry et al.* is cited as allegedly teaching a telecommunications network with a central switching gear for switching different channel and interface units. However, even if the teachings of *Perry et al.* were combined in the manner proposed, the claimed invention would not result. Namely, *Perry et al.* fails to cure the deficiencies previously noted in the connection with the teachings of *Gärtner et al.* Thus, reconsideration and withdrawal of the rejection is respectfully requested.

Claims 37 and 38 stand rejected under 35 U.S.C. §103(a) as being obvious over *Debbaut et al.* in view of *Gärtner et al.*, and further in view of U.S. Patent No. 5,841,836 to *Dunn et al.* (hereafter "*Dunn et al.*") on the ground set forth on page 9 of the Official Action. This rejection is respectfully traversed.

*Dunn et al.* is cited as allegedly teaching a telecommunications network with ASDL and HDSL lines in order to transfer data to customers. However, even if the teachings of *Dunn et al.* were combined in the manner proposed, the claimed invention would not result. Namely, the teachings of *Dunn et al.* are insufficient to cure the previously described deficiencies noted in connection with the teachings of *Gärtner et al.* Reconsideration and withdrawal of the rejection is respectfully requested.

Claim 44 stands rejected under 35 U.S.C. §103(a) as being obvious over *Hsu* on the grounds set forth on page 10 of the Official Action. This rejection is respectfully traversed.

The deficiencies of *Hsu* have been discussed above, and are incorporated herein by reference. In addition, as acknowledged on page 10 of the Official Action, *Hsu* also fails to disclose the annealing process having the parameters required by claim 44. Nonetheless, it is alleged, without proper support, that it would have been obvious to "find out the optimum conditions for the controlled variable" in the prior art. This ground for rejection is clearly based upon the improper use of hindsight, and lacks support within the teachings of the prior art itself. Thus, the rejection is improper for at least this additional reason.

***CONCLUSION***

From the foregoing, further and favorable action in the form of a Notice of Allowance is earnestly solicited. Should the Examiner feel that any issues remain, it is requested that the undersigned be contacted so that any such issues may be adequately addressed and prosecution of the instant application expedited.

Respectfully submitted,

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